

Appl. No. : 10/626,216
Filed : July 23, 2003



IN THE CLAIMS:

Please add new Claims 25-28 as follows:

Please amend Claims 1, 11, 14, and 20 as follows:

1. (Currently Amended) An internal combustion engine comprising a lubrication system arranged to lubricate at least a portion of the engine with lubricant, the lubrication system having a lubrication pump that pressurizes the lubricant toward the portion of the engine, a first sensor configured to sense an engine speed of the engine, a second sensor configured to sense an engine load of the engine, and a control device configured to control the lubrication pump, the control device determining an amount of lubricant that is pressurized by the lubrication pump based upon outputs from the first and second sensors to control the lubrication pump, such that the amount of lubricant is changed in accordance with changes in engine load sensed by the second sensor.

2. (Original) The engine as set forth in Claim 1, wherein the lubrication pump includes a solenoid driving a piston, the solenoid configured to move the piston toward a first position so as to discharge lubricant from the lubrication pump.

3. (Original) The engine as set forth in Claim 2, wherein the solenoid is configured to move the piston toward the first position when the solenoid receives an energization signal from the control device.

4. (Original) The engine as set forth in Claim 3, wherein the control device is configured to reduce the duration of the energization signal so as to minimize the time over which the piston is held at the first position.

5. (Original) The engine as set forth in Claim 3, wherein the control device is configured to determine an adjusted energization signal sufficiently long to cause the piston to move to the first position and shorter than a longest energization signal output from the control device.

6. (Original) The engine as set forth in Claim 3, wherein the control device is configured to change a duration of the energization signal based on changes in engine speed.

7. (Original) The engine as set forth in Claim 3, wherein the control device is configured to change a duration of the energization signal based on changes in engine load.

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8. (Original) The engine as set forth in Claim 7, wherein the control device is configured to change a duration of the energization signal based on changes in engine speed.

9. (Original) The engine as set forth in Claim 3, wherein the control device is configured to change a duration of the energization signal based on changes in at least one of engine speed, engine load, engine temperature, and lubricant temperature.

10. (Original) The engine as set forth in Claim 1 additionally comprising an air intake system arranged to supply air to a combustion chamber of the engine, the intake system having a throttle valve that regulates an amount of the air, the second sensor sensing a position of the throttle valve.

11. (Currently Amended) An internal combustion engine comprising a lubrication system arranged to lubricate at least a portion of the engine with lubricant, the lubrication system having a lubrication pump that periodically pressurizes the lubricant toward the portion of the engine, a first sensor configured to sense an engine speed of the engine, a second sensor configured to sense an engine load of the engine, and a control device configured to control the lubrication pump, the control device determining a frequency of periodic pressurization by the lubrication pump based upon outputs from the first and second sensors to control the lubrication pump, such that the frequency of periodic pressurization is changed in accordance with changes in engine load.

12. (Original) The engine as set forth in Claim 11, wherein the control device is configured to transmit an energization signal to the lubrication pump, wherein the duration of the energization signal is based upon at least one of outputs from the first and second sensors.

13. (Original) The engine as set forth in Claim 11 additionally comprising a third sensor configured to sense a temperature of the lubricant or the engine, the control device adjusting the frequency based upon an output from the third sensor.

14. (Currently Amended) A control method for a lubrication system that lubricates at least a portion of an engine, the method comprising sensing an engine speed of the engine, sensing an engine load of the engine, determining an amount of lubricant that is pressurized by a lubrication pump based upon the sensed engine speed and the sensed engine load such that the amount of lubricant is changed in accordance with changes in

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engine load, and actuating the lubrication pump to pressurize the determined amount of lubricant.

15. (Original) The control method as set forth in Claim 14 additionally comprising sensing a position of a throttle valve that regulates an amount of air to a combustion chamber of the engine to sense the engine load.

16. (Original) The control method as set forth in Claim 14, wherein the lubrication pump periodically pressurizes the lubricant, the method additionally comprising determining a frequency of periodic pressurization by the lubrication pump based upon at least the sensed engine speed or the sensed engine load.

17. (Original) The control method as set forth in Claim 16 additionally comprising sensing a temperature of the lubricant or the engine, and adjusting the frequency based upon the sensed temperature of the lubricant or the engine.

18. (Original) The control method as set forth in Claim 14 additionally comprising determining a duration of an energization signal for the lubrication pump based upon at least the sensed engine speed or the sensed engine load.

19. (Original) The control method as set forth in Claim 18 additionally comprising detecting changes in engine speed, detecting changes in engine load, and changing the duration of the energization signal when at least one of the engine speed and the engine load changes.

20. (Currently Amended) A control method for a lubrication system that lubricates at least a portion of an engine, the lubrication system having a lubrication pump periodically pressurizes lubricant, the method comprising sensing an engine speed of the engine, sensing an engine load of the engine, determining a frequency of periodic pressurization by the lubrication pump based upon the sensed engine speed and the sensed engine load, changing the frequency of periodic pressurization in accordance with changes in engine load, and actuating the lubrication pump to pressurize the lubricant with the determined frequency.

21. (Original) The control method as set forth in Claim 20 additionally comprising determining a pressurization time of the lubrication pump based upon at least the sensed engine speed or the sensed engine load.

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22. (Original) The control method as set forth in Claim 20 additionally comprising sensing a temperature of the lubricant or the engine, and adjusting the frequency based upon the sensed temperature of the lubricant or the engine.

23. (Original) An internal combustion engine comprising a lubrication system arranged to lubricate at least a portion of the engine with lubricant, the lubrication system having a lubrication pump that pressurizes the lubricant toward the portion of the engine, a first sensor configured to sense an engine speed of the engine, a second sensor configured to sense an engine load of the engine, a control device configured to control the lubrication pump, and means for minimizing the electrical energy used for powering the lubrication pump by reducing a dwell time of the lubrication pump, based on changes in at least one of engine load and engine speed.

24. (Original) An engine as set forth in Claim 23, wherein the lubrication pump includes a solenoid, wherein the dwell time corresponds to a time over which the solenoid remains energized without moving.

25. (New) The engine as set forth in Claim 1, wherein the control device is configured to minimize the electrical energy used for powering the lubrication pump by reducing a dwell time of the lubrication pump, based on changes in at least one of engine load and engine speed.

26. (New) The engine as set forth in Claim 11, wherein the control device is configured to reduce the electrical energy used for powering the lubrication pump by reducing a dwell time of the lubrication pump, based on changes in at least one of engine load and engine speed.

27. (New) The control method as set forth in Claim 14 additionally comprising minimizing the electrical energy used for powering the lubrication pump by reducing a dwell time of the lubrication pump, based on changes in at least one of engine load and engine speed.

28. (New) The control method as set forth in Claim 20 additionally comprising reducing the electrical energy used for powering the lubrication pump by reducing a dwell time of the lubrication pump, based on changes in at least one of engine load and engine speed.